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Program Overview

Metro Wastewater Reclamation District (Metro District) applies biosolids to their properties near Deer Trail, Colorado. These biosolids applications could affect the quality of water in alluvial and bedrock aquifers, streambed sediments, soils, and crops. Water quality can be directly affected through:

- Contaminated recharge water, or
- Infiltration of water through contaminated soils or sediments (remobilization).

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USGS

The U.S. Geological Survey is a science organization that provides the Nation with reliable, impartial information to describe and understand the Earth. The national USGS home page: <http://www.usgs.gov>

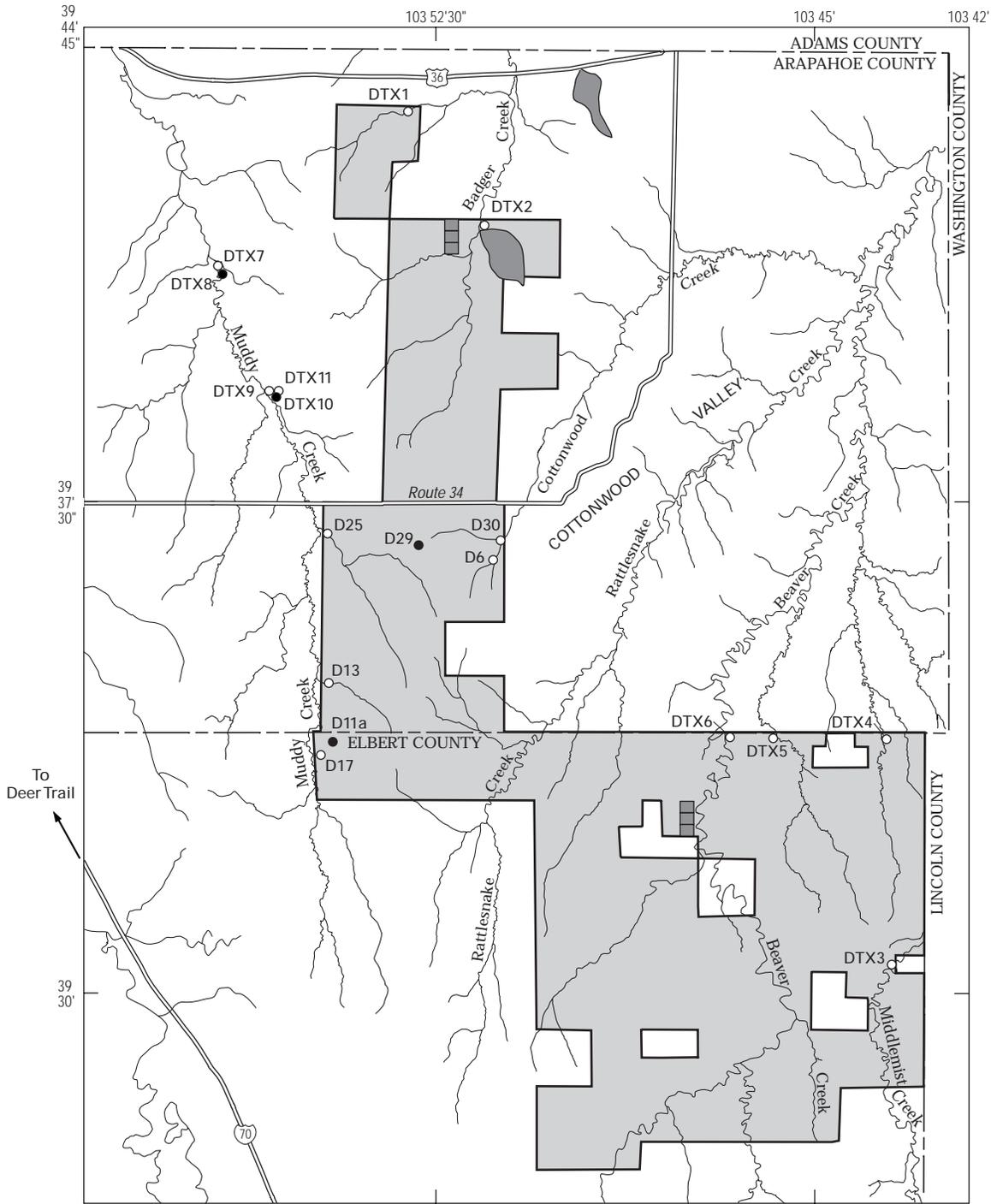
This USGS program:

The Internet address for this program, including links for data and reports, is:
<http://co.water.usgs.gov/projects/CO406/CO406.html>

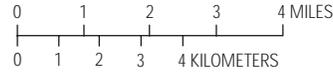
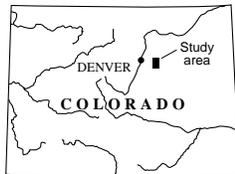
The Internet address for just the data is:
<http://co.water.usgs.gov/projects/CO406/data.html>
or <http://water.usgs.gov/co/nwis>



During 2001, runoff was sufficient to enable streambed-sediment sampling in the designated sampling basins three times: July 27, August 17, and September 1. Not all sample data have been received from the laboratory, so the data are not included in this progress report.



To Deer Trail



EXPLANATION

-  Metro Wastewater Reclamation District property
-  Streambed-sediment sampling area
-  USGS alluvial monitoring well
-  USGS bedrock monitoring well
-  Soil-sampling area

USGS Expanded Monitoring Program sites and Metro District's biosolids-application properties near Deer Trail, Colorado

Program Overview

Continued from page 1

Water quality can be indirectly affected through:

- Plowing that mobilizes or changes subsurface chemical constituents, or
- Contributions to natural processes such as nitrification.

Contaminated ground water or surface water could contaminate:

- Other aquifers, such as bedrock water-supply aquifers or alluvial aquifers,
- Other surface-water bodies (ponds or streams), or
- Streambed sediments.

Biosolids must meet metals and radioactivity regulations, or else agronomic loading rates will be incorrect and soils could be overloaded. Soil quality could either be improved by biosolids applications through increased nutrients and organic matter, or degraded through excessive nutrients or metals.

The U.S. Geological Survey (USGS) has designed and begun a new monitoring program to address concerns from a stakeholder group about the biosolids and the quality of the environment in the vicinity of the biosolids-application areas. The new USGS monitoring program near Deer Trail is referred to as the "USGS Expanded Monitoring Program" and began in January 1999.

This monitoring program is distinct from, but builds on, another USGS program that monitored shallow ground-water quality on the Metro District Central Farm from 1993-1998. The new program (1999-2005) considers environmental-quality issues for shallow and deep ground water, surface water (bed sediments), biosolids, soils, and crops. The new expanded monitoring program includes all three Metro District properties (North, Central, and South Farms) and related private-property locations. Both programs, however, use USGS and Metro District funds. In addition, the new monitoring program also uses funds from the North Kiowa Bijou Groundwater Management District. Both programs are designed, carried out, and interpreted independently by USGS, and quality-assured USGS data and reports will be released to the public and the Metro District at the same time. By definition and design, all USGS monitoring programs are independent and unbiased.

The objectives of the new Expanded Monitoring Program are to: (1) Evaluate the combined effects of biosolids applications, land use, and natural processes on alluvial aquifers, the bedrock aquifer, streambed sediments, soils, and crops by comparing chemical data to

- State or Federal regulatory limits,
- Data from a site where biosolids are not applied (a control site), or
- Earlier data from the same site (trends).

(2) Monitor biosolids for metals and radioactivity, and compare the concentrations with regulatory limits. (3) Determine the aquifer hydrology in this area.

The approach is unique for each component of the Expanded Monitoring Program. However, appropriate USGS methods and technologies will be applied to each component.

Progress reports such as this one were prepared quarterly for the first 2.5 years of the program and now are prepared twice each year and distributed to the stakeholders and other concerned people, as well as available to the general public on the Internet (<http://co.water.usgs.gov>). Each progress report will summarize progress from the previous quarters and plans for the current quarters; chemical data will be included twice each year. A USGS report will be prepared annually and made available after each year of the monitoring program: the reports will include data for that year, any interpretations for that year, and statistical analysis for the data to date. A comprehensive USGS report will be prepared and available after five years of monitoring that includes complete statistical analyses and interpretations. In addition, the USGS will meet with the stakeholders once a year to discuss the Expanded Monitoring Program results and to consider possible changes to the Expanded Monitoring Program.

Questions & Answers

Q: Has anyone received a USGS Quarterly Report for this project since the April-June 2001 issue was mailed out last September?

A: No. The stakeholders present at the annual meeting September 24, 2001, agreed that the USGS should prepare and distribute progress reports two times per year (with data in both issues) instead of quarterly. The current issue (July-December 2001) is the next progress report after the April-June 2001 issue.

Q: Why is there only one data table in this edition?

A: Analyses, reporting, or review for the other USGS 2001 samples are incomplete. The laboratories do not release data for all the samples at once, but release data incrementally. For example, analyses for carbon, nitrogen, and radiochemistry have been completed for the 2001 streambed-sediment samples, but the analyses for metals were not completed in time for inclusion in this report. USGS will release remaining sample data in future editions of these progress reports when the data packages are completed.

Alluvial Ground Water

Approach

Six monitoring wells were installed near the Metro District property boundaries in the major alluvial aquifers. These six wells plus five existing USGS monitoring wells will be sampled approximately quarterly for full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (July–December 2001)

Ground-water levels were measured July 4, August 2, September 6, October 4, November 2, and December 6, 2001. Ground water was sampled for chemistry in July and October 2001. Ground-water data were compiled and reviewed. More reviews of the interpretive hydrogeology report for ground water 1993-99 (which includes data and interpretations for some sites included in the expanded monitoring program) were completed. The annual report for 1999 was submitted to the USGS for final approval in September. A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September.

Plans for the Current Period (January–June 2002)

Ground-water levels will be measured the first week of each month. Ground water will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. Changes suggested by review comments will be incorporated into the various draft reports.

Bedrock Ground Water

Approach

A structure map of the base of the bedrock aquifer was compiled and used to determine locations for two sets of new, paired wells (one alluvial well and one nearby dual-completion bedrock well comprise each pair). The well pairs were installed where both the Muddy Creek alluvial aquifer and the Laramie-Fox Hills aquifer are present (along the margin of the bedrock aquifer) near the Metro District properties. Water-level data from each well pair will be used to determine aquifer hydrology and interaction at those two locations. The two new bedrock wells (DTX8, DTX10), along with an existing USGS bedrock well (D29), will be sampled approximately quarterly for

full inorganic chemistry and annually for radioactivity. Data will be reviewed and statistically tested for exceedance of regulatory limits and for trends.

Progress Last Period (July–December 2001)

Ground-water levels were measured July 4, August 2, September 6, October 4, November 2, and December 6, 2001. Ground water was sampled for chemistry in July and October 2001. Ground-water data were compiled and reviewed. More reviews of the interpretive hydrogeology report for ground water 1993-99 (which includes data and interpretations for some sites included in the expanded monitoring program) were completed. The annual report for 1999 was submitted to the USGS for final approval in September.

Continued on page 5



Air-temperature data from the continuous-recorder sites are quality assured by comparison with air-temperature data from thermometers during site visits.

Bedrock Ground Water

Continued from page 4

A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September.

Plans for the Current Period (January-June 2002)

Ground-water levels will be measured the first week of each month. Ground water will be sampled the first month of each quarter, weather permitting. Data will be compiled and reviewed. Changes suggested by review comments will be incorporated into the various draft reports.



USGS ground-water samplers review the sampling protocol before processing the first sample to make sure all the steps of the complicated protocol are remembered.



Some bottles of each ground-water sample require a chemical (acid) preservative before analysis. This chemical preservative is added to the sample in the field inside a clean chamber after the bottle has been filled to the appropriate level with sample water.



The low concentrations of most ground-water constituents at this site require that a clean-hands protocol be used to prevent contamination during sample processing.

Surface-Water Sediments

Approach

Surface-water contamination is a concern for the stakeholders, but

streams flow off the Metro District properties only during runoff when surface-water sampling is impractical. Therefore, possible surface-water contamination from metals will be evalu-

Continued on page 6

Surface-Water Sediments

Continued from page 5

ated by sampling streambed sediments soon after storms. Two small drainage basins were selected for similar characteristics but different land use—one drainage in a biosolids-application field and another drainage in a farmed field (not on the Metro District properties) that does not receive biosolids. A downstream location in each of the two drainage basins will be sampled after the same storms, three to four times per year for inorganic constituents (including metals, total nitrogen, and total phosphorous) and organic carbon, and one time per year for radioactive constituents. Data will be reviewed and statistically tested to determine if concentrations are significantly different between the two drainage basins.

Progress Last Period (July-December 2001)

The site was carefully monitored for runoff-producing rainfall. Runoff was sufficient to enable streambed sampling three times in the designated basins: July 27, August 17, and September 1, 2001. The annual report for 1999 was submitted to the USGS for final approval in September. A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September.

Plans for the Current Period (January-June 2002)

The site will be monitored for runoff-producing rainfall. Sampling may take place, depending on the weather. Data will be compiled and reviewed. Changes suggested by review comments will be incorporated into the various draft reports.

Biosolids

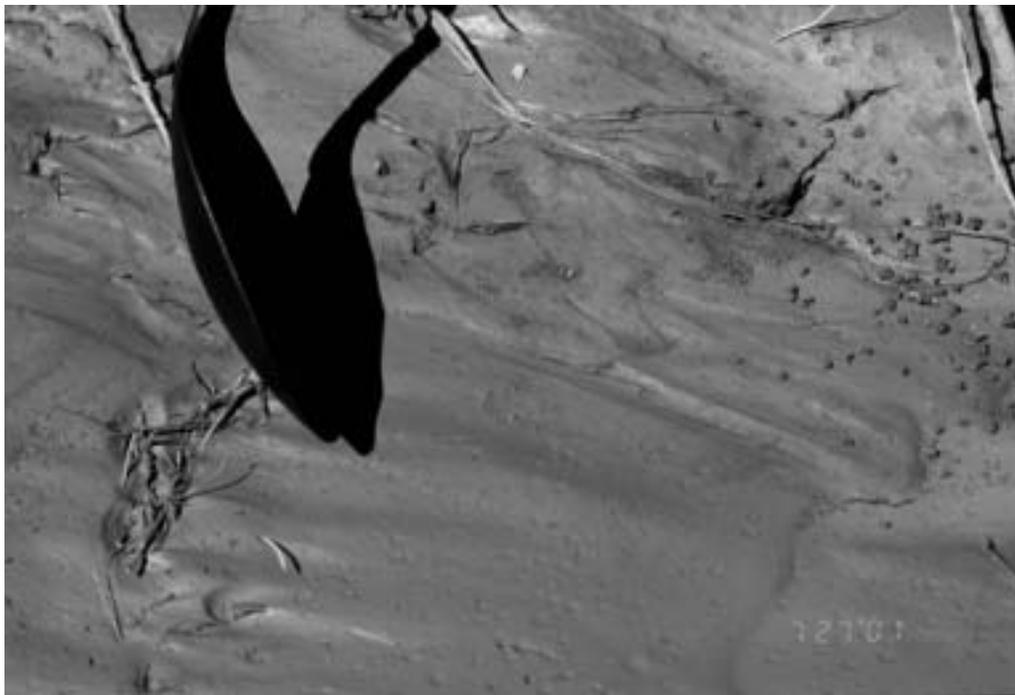
Approach

Biosolids samples will be taken as a 24-hour composite from the Metro District plant and analyzed by USGS. Biosolids will be sampled and analyzed once each quarter during most of the program, and once each month for 6 months when the Lowry Landfill Superfund Site water transfer begins. Data will be reviewed and compared to Federal regulatory limits.

Progress Last Period (July-December 2001)

Quarterly samples of biosolids were collected July 21 and October 19, 2001. Each sample was a 24-hour composite from the conveyor belt at the Metro District facility. The material was placed in two acid-washed, one-gallon

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For this project, the USGS samples streambed sediments only in the channels of the designated basins and only from wet areas with fresh sediment deposits, as in the photo above. If no evidence of runoff from the farmed slopes of the basins is visible, no samples are collected because sampling is designed to target constituents such as biosolids from the runoff water.

Biosolids

Continued from page 6

plastic bottles and transported to the USGS in Denver. There, the sample was air-dried then ground to less than 150 micrometers. The samples were submitted to the laboratories for chemical analyses. A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September. A paper and a poster about the biosolids, soils, and crops monitoring components were presented at the 6th International Conference on the Biogeochemistry of Trace Elements held in Guelph, Ontario, Canada during July 2001.

Plans for the Current Period (January-June 2002)

Quarterly biosolids samples will be collected in January and April 2002. Samples will be dried, ground, and submitted to the laboratories. Data will be compiled and reviewed.



Dave Smith of the USGS picks up the July biosolids sample from the Metro Wastewater Reclamation District Laboratory.

Soils

Approach

One site was selected for characterizing and monitoring the chemical composition of soil on the Metro District property in Arapahoe County, and one site was selected on the Metro District property in Elbert County. Each site consists of three 20-acre (933 feet by 933 feet) fields separated by 100-foot buffer zones. The center 20-acre field at each site will have biosolids applied after the initial soil sampling. The other two 20-acre fields at each site will not have biosolids applied and will be used as “control” fields to monitor the natural variability of soil composition for the duration of the study. All three 20-acre fields at each site will be farmed in the normal fashion and have crops planted and harvested. Soils from each of the six fields will be sampled before biosolids are applied to the two center fields and then again after each harvest. Samples will be analyzed for arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, zinc, plutonium, and gross alpha and beta activity. Data will be examined after 5 years to determine if concentration has changed with time.

Progress Last Period (July-December 2001)

Soil samples from the Arapahoe County site collected during June 2001 were submitted to the laboratories for chemical analyses. A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September. A paper and a poster about the biosolids, soils, and crops monitoring components were presented at the 6th International Conference on the Biogeochemistry of Trace Elements held in Guelph, Ontario, Canada during July 2001.

Plans for the Current Period (January-June 2002)

Data will be compiled and reviewed.

Crops

Approach

Crops from each of the six 20-acre soil-monitoring fields will be chemically analyzed after harvest. Analyses will include arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc.

Progress Last Period (July-December 2001)

A reviewed draft of the annual report for 2000 was completed and presented to stakeholders in September. A paper and a poster about the biosolids, soils, and crops monitoring components were presented at the 6th International Conference on the Biogeochemistry of Trace Elements held in Guelph, Ontario, Canada during July 2001.

Plans for the Current Period (January-June 2002)

Samples of wheat and millet will be collected from the Arapahoe and Elbert County sites.

If you have changes to the mailing list, please contact the Elbert County Environmental Health Officer (see page 12) or Tracy Yager (see page 12). Elbert County maintains the mailing list for these quarterly reports and for all meeting notices.

If you have questions about the Expanded Monitoring Program, please contact Tracy Yager (see page 12). Commonly asked questions will be included in each Progress Report.

USGS ground-water data, July–December 2001

[Standards from Colorado Department of Public Health and Environment, 1997, Basic standards for ground water, 5CCR 1002-41: July 14, 1997, 56 p. Data are preliminary and subject to revision. All data from filtered samples; mg/L, milligrams per liter; µg/L, micrograms per liter; <, less than; E, value estimated by laboratory; ER, value is an estimate because reanalysis for that constituent has been requested]

Well	Sample date	Time	Nitrate plus nitrite as nitrogen, mg/L	Arsenic, µg/L	Cadmium, µg/L	Chromium, µg/L	Copper, µg/L	Lead, µg/L	Mercury, µg/L	Molybdenum, µg/L	Nickel, µg/L	Selenium, µg/L	Zinc, µg/L
DTX3	07/10/01	1430	6.02	< 2.0	E 0.04	1.1	5.9	E 0.05	< 0.01	0.5	< 0.30	14.2	4
DTX3	10/10/01	1340	ER15.9	< 2.0	E .02	E .6	5.5	< .08	< .01	.6	< .60	12.5	3
D17	07/09/01	1315	2.03	E 1.5	E .02	< .8	.5	< .08	< .01	6.1	.90	6.8	< 1
D17	10/16/01	1210	1.90	E 1.2	E .02	< .8	.8	< .08	< .01	6.1	1.12	7.7	< 1
DTX4	07/11/01	1430	.592	E 1.3	< .07	.9	8.9	< .20	< .01	.6	2.58	3.5	6
DTX4	10/11/01	1530	< .190	< 2.0	.16	2.4	18.5	< .20	< .01	.9	2.25	< 2.0	13
DTX5	07/12/01	1240	.254	< 2.0	< .07	1.1	8.5	< .20	< .01	1.1	.28	E 2.3	6
DTX5	10/11/01	1430	.059	E 1.2	.08	1.9	16.6	< .20	< .01	1.0	< .60	E 1.3	13
DTX6	07/12/01	1420	.327	< 2.0	< .07	4.7	11.4	< .20	< .01	.7	< .10	3.8	8
DTX6	10/11/01	1300	.345	E 1.0	E .04	2.0	27.5	< .20	< .01	.7	< .60	3.4	15
D13	07/13/01	0955	< .037	< 2.0	< .04	.9	5.0	< .08	< .01	1.0	.29	< 2.0	2
D13	10/15/01	1010	.042	< 2.0	< .04	< .8	5.7	< .08	< .01	1.0	< .60	< 2.0	3
D29	07/09/01	1115	< .037	< 2.0	< .07	2.7	12.4	E .08	< .01	.9	7.60	E 1.8	11
D29	10/10/01	1040	.053	E .9	E .07	2.7	23.0	< .20	< .01	2.4	.50	E 1.4	25
D6	07/10/01	1015	16.0	2.4	E .22	E 1.1	58.7	.62	< .01	3.3	5.90	14.4	43
D6	10/10/01	1545	15.9	ER 3.8	E .25	< 1.6	103	E .32	< .01	3.2	1.13	23.8	82
D30	07/10/01	1240	< .037	E 1.0	E .07	2.4	15.6	< .20	< .01	3.0	< .20	E 1.3	11
D30	10/16/01	1000	.041	< 2.0	.27	< 4.0	ER 433	< .20	< .01	ER44.0	ER 85.4	< 2.0	ER242
D25	07/09/01	1500	1.62	2.7	.17	3.0	12.0	< .20	< .01	9.8	E < .10	E 1.8	7
D25	10/15/01	1150	4.80	2.6	.23	2.7	28.5	< .20	< .01	10.4	< .60	2.6	14
DTX10A	07/12/01	1020	< .037	< 2.0	< .07	< .8	7.8	< .20	< .01	1.4	< .10	E 1.7	6
DTX10A	10/15/01	1345	.058	E 1.1	< .07	E .8	19.1	< .20	< .01	1.3	< .60	E 1.3	10
DTX8A	07/11/01	1230	< .037	< 2.0	< .04	< .8	3.4	< .08	< .01	.5	< .06	< 2.0	2
DTX8A	10/12/01	1400	.040	< 2.0	< .04	< .8	7.2	< .08	< .01	.5	< .60	< 2.0	4
DTX2	07/13/01	1150	< .037	< 2.0	< .07	3.2	12.6	< .20	.01	1.5	3.81	< 2.0	8
DTX2	10/12/01	1130	.046	< 2.0	< .07	2.1	23.5	< .20	< .01	1.4	< .60	< 2.0	14
DTX1	07/11/01	1635	1.25	2.7	E .04	.9	11.7	< .20	< .01	5.7	9.46	3.1	8
DTX1	10/12/01	0950	1.42	2.4	.11	1.4	21.7	< .20	< .01	6.2	1.67	E 1.9	11
Human Health Standard			10	10	5	100	1,000	50	2	None	100	50	5,000
Agricultural Standard			100	100	10	100	200	100	10	None	200	20	2,000



The channel areas of the designated streambed-sediment sampling basins are not large river beds but narrow temporary streambeds with vegetation growing in some reaches of the channel. The person sampling streambed sediments walks along the streambed of the basin sampling from all the newly deposited sediments from rainfall runoff. The resulting sample for that basin is a composite from all the new sediment deposits in the channel of that designated sampling basin.



After streambed-sediment samples are collected from the field sites, the samples are kept chilled while they are processed in preparation for laboratory analyses. Sample processing is done in the USGS preparatory laboratory in Denver and includes homogenizing the composite sample by stirring, as well as sieving and bottling the sample for the appropriate analysis. Each sample is processed with separate equipment that is thoroughly cleaned between sampling trips to eliminate cross-contamination between samples.



Different sieves are used to prepare the streambed-sediment samples for different analyses. Nylon sieve cloth is used to prepare the samples for trace-element analysis, as shown in the photo above.



The chain-of-custody forms are signed by both USGS and contract-laboratory staff when the USGS delivers streambed-sediment samples to the laboratory for nitrogen analyses. Other analyses are done by the USGS laboratory in Denver, in which case the samples never leave the USGS and chain-of-custody forms are not used.



The annual stakeholder meeting was held in Kiowa, Colorado, on September 24, 2001. Presentations were made by the USGS about the Expanded Monitoring Program and by the Metro Wastewater Reclamation District about the farm program and the Lowry water transfer.

Definitions

Analytical uncertainty—The possible range of the true value or error term contributed by bias and variability of the laboratory measurement technique. All laboratory data have associated uncertainty. Each sample value should be thought of as a range in concentration defined by the reported value plus or minus the analytical uncertainty. The true concentration usually is somewhere in this range, but not a precisely known point. For most analyses, the analytical uncertainty is not calculated for each sample but is estimated from bias and variability data derived from analyses of quality-assurance samples like blanks and replicates. For radionuclide data, the analytical uncertainty is calculated individually for each sample for each analyte based on analytical and statistical variables.

Biosolids—Solid organic matter recovered from a sewage-treatment process that meets regulatory criteria for beneficial use, such as for fertilizer. Metro District applies Grade I, Class B biosolids at Deer Trail. Regulations require that land-applied biosolids must meet or exceed Grade II, Class B. Grade I exceeds Grade II.

Composited sample—A sample made by combining individual subsamples into a single sample. Each streambed-sediment sample from this program usually is a field-composited sample because the sample contains sediments from more than one depositional area of the streambed.

Less than (<)—A designation for analytical results to indicate that a constituent was not present or was present at very low levels that the laboratory could not reliably determine. Note that the actual amount of this constituent in that sample is unknown and could be any amount between zero and the “less than” value.

Runoff—The rain that hits the ground and flows over the land surface into valleys instead of infiltrating into the soil. Runoff can wash particles of soil, rock, plants, and biosolids from the land surface into the streambeds of the valleys.

Stakeholder—Any person or group (including the Metro District) interested or concerned about the Expanded Monitoring Program.

Contacts

USGS: Tracy Yager, 303-236-4882, ext. 225 (*email*: tjyager@usgs.gov)
Dave Smith, 303-236-1849
Jim Crock, 303-236-2452

Metro District: Duane Humble, 303-286-3267
(*email*: DHumble@mwr.dst.co.us)

Elbert County Environmental Health Officer: 303-621-3144
(*email*: elconurse@bewellnet.com)

State Biosolids Contact: Rick Koplitz, 303-692-3618

U.S. Environmental Protection Agency: Bob Brobst, 303-312-6129

***Third annual stakeholder
meeting was held
September 24, 2001, at the Elbert
County Courthouse in Kiowa***

Prepared by Tracy Yager, Dave Smith, and
Jim Crock (USGS) in cooperation with
Metro Wastewater Reclamation District,
February 2002

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